REMARKS

This application has been reviewed in light of the Office Action mailed on February 18, 2005. Claims 15-19, 24, 29, 30, 79, 82, 85 and 88 are pending. No amendments are provided with this response.

Claim Rejections - 35 U.S.C. §103

The Examiner notes that the application currently names joint inventors. In considering the patentability of the claims under 35 U.S.C. §103(a) the Examiner presumed that the subject matter of the various claims was commonly owned at the time the inventions were made. The Applicants confirm that the Examiner's presumption is correct.

Claims 15-18, 19/15-18, 24/15-18, 29/15-18, 30/15-18, 79, 82, 85 and 88 stand rejected under 35 U.S.C. §103(a) as being allegedly unpatentable over the Campbell et al. '712 patent in view of the Houschmand et al. patent. The Examiner contends that Campbell et al. '712 discloses Applicants' basic inventive concept substantially as claimed, with the exception of liquefying the removed vapor stream. The Examiner asserts that Houschmand et al. shows liquefying the methane rich vapor from a column (208) by compressing 72 and cooling 80 the stream to be old in the natural gas processing art. The Examiner concludes that it would have been obvious to one of ordinary skill in the art from the teaching of Houschmand et al. to modify the natural gas processing system of Wilkinson et al. '507 by compressing and cooling the methane rich vapor stream to produce liquefied natural gas which is more economical to store and transport.

The Claimed Invention

The pending claims cover the Applicants' Advanced Natural Gas Liquids

Extraction ("ANGLE") process having Improved Overhead Recycle ("IOR") features. The claimed embodiment is illustrated in FIGS. 4, 10 and 11 in the instant application. Each of the pending claims includes steps whereby either a cooled natural gas stream or a vapor stream separated from a partially condensed natural gas stream is expanded to an intermediate pressure and directed to a contacting device, thereby forming a volatile residue gas fraction and a liquid stream. The liquid stream is heated and directed into a distillation column where it is separated into a more volatile vapor distillation stream and a relatively less volatile fraction containing a major portion of the heavier hydrocarbon components. The more volatile vapor distillation stream is cooled to form another liquid stream which is intimately contacted with either the expanded cooled natural gas stream or the expanded vapor stream in the contacting device. The volatile residue gas fraction is cooled under pressure to form the condensed stream which is expanded to form LNG.

Distinctions Between the Claimed Invention and the Cited Prior Art

The Applicants' respectfully disagree with the Examiner's contention that the Campbell et al. '712 patent "discloses applicants' basic inventive concept". Each of the claims at issue is directed to "a process for liquefying a natural gas stream containing methane and heavier hydrocarbon components". U.S. Patent No. 5,771,712 ("the Campbell et al. '712 Patent") discloses "a process for the separation of a gas containing hydrocarbons". Column 1 lines 7-8. U.S. Patent No. 5,799,507 ("the Wilkinson et al. '507 patent") which is also cited in the Office Action, also discloses "a process for the separation of a gas containing hydrocarbons". Column 1, lines 4-5. The processes described and illustrated in the Campbell et al. '712 patent and the Wilkinson et al. '507

patent are natural gas liquid or NGL processes. *See,* Campbell et al. '712 patent, column 1, lines 30-31 and Wilkinson et al. '507 patent, column 1, line 27. Liquefied natural gas (LNG) is not mentioned in either the Campbell et al. '712 patent or the Wilkinson et al. '507 patent, and there is no suggestion in either patent that natural gas can be liquefied in any way. Thus, the Applicants respectfully disagree that the Campbell et al. '712 patent should be regarded as a primary reference, and they also disagree that the Wilkinson et al. '507 patent should be regarded as pertinent to the instant application.

U.S. Patent No. 5,615,561 ("the Houshmand patent") discloses a method "for liquefying natural gas using a cryogenic process". Abstract, lines 1-2. As such, the Applicants submit that the Houshmand patent should be regarded as the primary reference in considering the patentability of the claims at issue in light of the cited art.

Columns 1 and 2 of the Houshmand patent describe various ways in which natural gas has been processed to produce LNG. The Houshmand patent states that:

> [a]nother type of plant which processes natural gas is the natural gas liquid (NGL) plant, which is used to recover NGLs. NGL recovery comprises liquefying and separating the heavier hydrocarbon components of natural gas (ethane, propane, butanes, gasolines, etc.) from the primarily methane fraction which remains in gaseous form (residue gas). The heavier hydrocarbons are worth more commercially as liquids than as natural gas. NGLs are sold as petrochemical feedstocks, gasoline blending components, and fuel. These plants also typically remove non-hydrocarbons such as water and carbon dioxide to meet gas pipeline restrictions on these components. There are hundreds of such NGL plans [sic] throughout the U.S. NGL plants include lean oil absorption plants, refrigeration plants, and cryogenic plants. To the best of the inventors knowledge, such plants are not presently used to produce LNG (liquid natural gas).

Column 2, line 63 to column 3, line 11.

As noted above, the Campbell et al. '712 and Wilkinson '507 patents disclose NGL

processes and give no indication that any element of those processes is applicable to producing LNG.

The Houshmand patent further states that:

> Existing LNG Peak Shavers, NRUs and natural gas processing plants used to recover NGLs may be modified to produce vehicular grade LNG fuel by the addition of fractionation systems and auxiliary refrigeration systems. Additional cryogenic distillation systems may be used to increase the LNG purity by removing ethane and heavier hydrocarbons from natural gas in order to produce fuel quality LNG. However, since installation of fractionators and auxiliary refrigeration systems is very expensive, this is not always an economically feasible approach for producing high-purity LNG suitable for vehicle fuel.

Column 3, lines 15-25.

The Houshmand patent then asserts that it provides "a novel manner in which a basic cryogenic NGL plant design can be modified to make a plant for producing high methane purity LNG without the need for additional fractionators and refrigeration systems." Column 3, lines 26-29. According to Houshmand, the "inventive process ***produces LNG by liquefying a slipstream*** of the residue gas exiting a cryogenic plants." Column 3, lines 45-47, emphasis added. Note that in each embodiment disclosed by Houshmand, only slipstream 210 is used to produce LNG. In each instance, the bulk of the gas processed in accordance with the Houshmand method is not LNG feedstock. In contrast, in accordance with the applicants' claimed process, essentially the entire natural gas stream is liquefied.

It is generally accepted in the LNG industry that the natural gas to be liquefied should be at as high a pressure as practical to reduce the amount of refrigeration needed for the liquefaction process. Most LNG plants use a "wash tower" at the front of the plant to

remove the C_5+ hydrocarbons from the natural gas so the heavier hydrocarbons do not freeze out in the liquefaction section and cause operating problems. This wash tower is not very efficient because it operates at high pressure, so it is not possible in most plants to recover much of the C_3-C_4 hydrocarbons, let alone the C_2 hydrocarbons.

Any of the heavier hydrocarbons that are not removed in the wash tower become constituents in the LNG along with the methane. While this may be acceptable for some users (such as those in Japan), the same will not be true when the United States and other western countries begin importing significant quantities of LNG. The pipeline infrastructure in the United States will require "cooler" LNG (lower BTU content) that does not contain significant quantities of C_3+ hydrocarbons. Further, in many of the areas where new baseload LNG plants are planned, there is a local market for the C_3-C_4 (and sometimes even the C_2) hydrocarbons, so capturing these hydrocarbons as a liquid co-product stream can add significant revenue for the plant owner.

The process of the Campbell et al. '712 patent could be used in front of an LNG plant to remove the C_3+ hydrocarbons from the natural gas before it proceeds to liquefaction. After recovery of liquids in the '712 patent column, the column residue gas would be heated (as it provides cooling of the natural gas feed to the '712 patent process) and recompressed back to the original inlet pressure. The residue gas would then flow to the LNG plant at high pressure and ambient temperature.

As an alternative to this stand-alone use of the '712 patent process, the Applicants began looking at the concept of integrating the '712 process into liquefaction processing. Instead of using the cold residue gas for the front-end heat exchange, they instead let it

flow to the liquefaction section directly from the '712 patent column, so that the gas was much colder than for a typical LNG plant, but at lower pressure. Instead of using the cold residue gas to provide front-end cooling for the '712 patent process, a small amount of the refrigeration from the liquefaction section is used to cool the feed gas. What the Applicants found with this concept is that not only did they produce a high-quality liquid co-product the (the C_3+ liquids from the '712 patent column), but the total refrigeration load for liquids recovery and liquefaction was significantly lower than the processes currently being used.

As explained in the specification of the instant patent application, the applicants believe the reduction in refrigeration load is due to two factors. First, using a work expansion machine to expand the high pressure feed gas to intermediate pressure generates refrigeration within the process itself, reducing the external refrigeration load. Second, by removing the heavier hydrocarbons at intermediate pressure (rather than high pressure), the relative volatilities between the light hydrocarbons and the heavy hydrocarbons are more favorable, allowing an easier, cleaner separation. A further benefit of this concept is that the work recovered in the work expansion machine can be used to partially recompress the reside gas, improving the condensing characteristics of the methane-rich stream to reduce the amount of heat exchange surface required to accomplish the liquefaction.

As noted above, the Houshmand patent describes a process that is only capable of producing a small slipstream of LNG. The process depicted in the Houshmand patent could not be used for a baseload LNG plant where essentially the entire natural gas stream is to be liquefied. The instant claimed invention, on the other hand, is specifically designed

for use in baseload LNG plants.

There is No *Prima Facie* Case of Obviousness

The Houshmand, Campbell et al. '712 and Wilkinson '507 patents do not support a *prima facie* case of obviousness. To establish a *prima facie* case of obviousness, three criteria must be met. First, there must be some suggestion or motivation in the cited references themselves or in the knowledge generally available to one of ordinary skill in the art to modify the reference or to combine reference teachings. Second, there must be a reasonable expectation of success. Third, the combined references must teach or suggest all the claimed limitations. The teaching or suggestion to make the claimed combination and the reasonable expectation of success must both be found in the prior art and must not be based on the applicants' disclosure. *In re Vaeck*, 947 F.2d 488, 20 USPQ 2d 1438 (Fed. Cir. 1991); MPEP § 2142.

In this case, there is no suggestion or motivation in any of the cited references to alter the Houshmand patent's process for producing LNG from a slipstream in an NGL plant by using any of the NGL process features of the Campbell et al. '712 or Wilkinson '507 patents. Fig. 10 in the instant application is an embodiment of the process of pending claim 15. A comparison of the baseload processing in Fig. 10 with any of the figures in the Houshmand patent demonstrates the distinctions between the processes that are described in detail above. Also, a comparison of Fig. 10 of the instant application with Fig. 4 of the Campbell et al. '712 patent or Fig. 5 of the Wilkinson '507 patent reveals that there is no hint in those references of the treatment of the column cold residue gas that occurs in the instant process and that is essential for the production of LNG.

Simply stated, the Houshmand patent discloses a modified cryogenic NGL process for producing slipstream quantities of LNG. The Campbell et al. '712 and Wilkinson '507 patents disclose cryogenic NGL processes for separating hydrocarbons, with no suggestion of LNG utility. Nothing in any reference suggests employing the improved overhead recycle feature of the Campbell et al. '712 patent or the single column overhead recycle feature of the Wilkinson '507 patent in any type of process to produce LNG. Moreover, such a suggestion or motivation for such a combination is not in the knowledge generally available to one of ordinary skill in the art, as Houshmand demonstrates. See Houshmand patent, column 3, lines 7-29. Accordingly, none of the criteria for establishing a *prima facie* case of obviousness has been met.

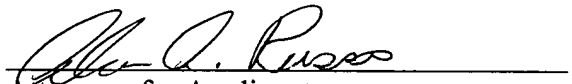
The pending claims require the heating of a liquid stream which is fed to a distillation column where it is separated and the resultant vapor distillation stream is cooled and then intimately contacted with either the expanded natural gas stream or the expanded vapor stream. The Houschmand and Wilkinson et al. '507 patents neither disclose nor suggest intimately contacting liquid with either the expanded natural gas stream or the expanded vapor in a contacting device.

Campbell et al. '712 discloses IOR processing, but offers no suggestion that such steps may be employed in natural gas liquefaction. There is no suggestion in any of the cited prior art to combine the teachings of Campbell et al. '712 with Houschmand and/or Wilkinson et al. '507. Neither Houschmand nor Wilkinson et al. '507 disclose the contacting device cited in the pending claims and Campbell et al. '712 does not hint that the disclosed steps may be employed in LNG processing.

With regard to the other bases for rejection asserted by the Examiner, the Applicants submit that the claims are patentable for all the foregoing reasons. Concerning the rejections of dependent claims 29, 30, 79, 82, 85 and 88, the Applicants submit that each claim is patentable for the reasons of patentability advanced above for the claims on which these claims depend.

In view of the foregoing distinctions, the applicants submit that the present invention is not suggested by the cited references. Accordingly, favorable reconsideration of the application is earnestly solicited.

Respectfully submitted,



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